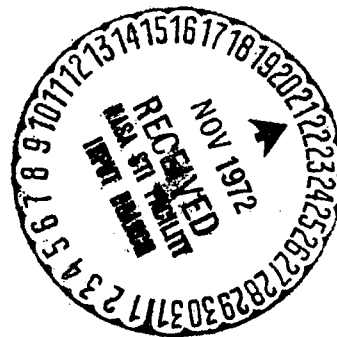PREPARATION FOR THE EOLE OPERATIONS
NOTE NO.5
OBJECT: DEFINITION PROJECT OF THE OPERATIONS (EXPERIMENT
PHASE) AND OF THE DATA FURNISHED BY THE CALCULATIONS CENTER

Centre National d'Etudes Spatiales
Centre Spatial de Bretigny

Translation of "Preparation des operations EOLE.
Note no.5. Objet: Projet de definition des
operations (phase experience) et des
donnes fournies par le Centre de
Calcul," CNES, Centre Spatial
de Bretigny, (NO.153/COBY),
Nov. 4, 1969, 20 pages.

PREPARATION FOR THE E O L E OPERATIONS

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definition des operations (phase experience) et des donnees
fournies par le Centre de Calcul", CNES, Nov.4,1969. (No.153/COBY)

II

NATIONAL SPACE STUDIES CENTER

SPACE CENTER OF BRETIGNY

Preparation for the

EOLE Operations

Note no. 5

Object: Definition project of the operations (experiment phase)

and of the data furnished by the Calculations Center.

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III

I - INTRODUCTION

This project of defining the EOLE operations is made while taking into account the following hypotheses and objectives:

- it is hardly probable that balloons evolving in the southern hemisphere cross the equator;

- there is no zone in the southern hemisphere in which the balloons will not be able to evolve;

- at the time of each passage of the satellite, the interrogation of the maximum number of balloons is desired;

- in order to face the circumstances of the moment, it should be possible to intervene rapidly and at any given moment in the operation of the system;

- the flotilla of balloons should be followed quantitatively and qualitatively;

- the control of the satellite is effected regularly;

- the data is received at each revolution and sent on to Bretigny by the 200 bauds equipment.

II - INTERROGATION OF THE BALLOONS

II-1 - OPERATION MODE OF THE SATELLITE

The interrogation of the balloon can be realized by the satellite according to two operation modes of the equipment:

- non programmed mode,

- programmed mode.

In non programmed mode, the equipment is put into operation and stopped by telecommand order. The implantation of the control stations of the network does not permit limiting the operation of the satellite to the southern hemisphere.

From that fact, this mode of operation is not permanently retained.

In programmed mode, the interrogation of the balloon is accomplished according to instructions which are transmitted to the satellite and stored in a memorandum.

II-2 TYPE OF CALL

The programmed mode offers the possibility of interrogating the balloons by means of several call types:

- "operation" sequential call   SM

- "destruction" sequential call   SD

- "finish" sequential call   SF   SF

- "operation" non sequential call   NSM

- "destruction" non sequential call   NSD

The different call types are described in note no. 3 "Preparation for EOLE operations" ref. 42/CODY of 3/25/69.

The "operation" sequential call (SM) is the one which is normally utilized since it permits interrogating the maximum number of balloons, the non sequential call is reserved for particular actions (destruction or intensive interrogation of one or several balloons).

II-3 PROTECTION OF THE NORTHERN HEMISPHERE

Although the probability of balloon penetration in the northern hemisphere is slight, it is possible to assure a partial protection by framing the passage of the satellite in the useful zone by a "destruction" sequential call, the times of call beginning being chosen in such a way that the spherical zone thus protected is tangent to parallel 10°N.

II-4 BASE TELEPOSTING

The solutions retained for the call type chosen and for assuring the protection of the northern hemisphere permit defining, for each revolution, a base teleposting (TAF) containing the following orders:

- "destruction sequential call   SD

- "operation" sequential call   SM

- "destruction" sequential call   SD

III - MODIFICATION OF THE BASE TAF

Modifications can be brought to the base TAF in the course of its elaboration and in the course of its execution.

These modifications have as principle causes:

- the failure of the station charged with transmitting the program to the satellite;

- the appearance of incidents on board the satellite in the course of programmed execution involving the resetting at zero of the TAF memorandum;

- the appearance of operation incidents of the satellite (power supply, etc.);

- particular demands coming from the Project Chief of the Scientific Director....

These modifications consist of:

- suppressing calls;

- introducing supplementary calls;

- nullifying all or part of the program.

IV - MANAGEMENT OF THE FLOTILLA

The management of the flotilla can be summarized as:

- periodically establishing a general location of the balloons in flight;

- knowing the list of balloons no longer answering in order to assure the effectiveness of the destruction orders and to cause new launching to proceed;

- checking the new balloons launched in order to assure that they are effectively integrated with those already in flight;

- supervising the general operation of the nacelle covering assembly.

V - SATELLITE CONTROL

The control of the satellite has as its goal verifying the proper functioning of the equipment on board and assuring that its attitude is always suitable.

A partial control is accomplished at the station by the decommutation/ visualization equipment.

Complete control is accomplished at Brètigny by calculator.

VI - COLLECTION OF THE DATA

Collection of the telemeasure data presents no new problems; on the other hand, the transmission of this data to Bretigny mobilizes the communication methods prohibiting all action in the Operation Center - Transmission Station direction.

VI - AUTOMATIC INFORMATION SUPPORT

(see logic schema in annex)

VI-1 BASE TAF

The calculator proposes the station charged with transmitting the program to the satellite in the following form:

STA - JR/MS/HRMN - HRMN

STA: 3 code letters from the station chosen

JR/MS/HRMN: Beginning moment of retained passage, given in months, day - hours - minutes.

HRMN: Transmission time limit of the TAF to the satellite given in hours minutes.

example PTA 19/10/0850 0900

After validation of the station, the calculator proposes a base TAF for a revolution in the form:

REVOL - JR/MS/HRMNSC - BAL-APL - POS . SAT

REVOL: revolution number

JR/MS/HRMNSC: Moment of call beginning in month - day - hour - minute - seconds.

BAL: Balloon number

APL: Type of call (SM - SD - SF - NSM - NSD)

Satellite position: Geographic coordinate of the satellite at the moment of beginning of call (3 siphers east longitude - 2 siphers preceded by the sign + or - for the north or south latitudes).

example 1789 19/10/0920 32 014 NSD 230 - 10

If the TAF proposed for one revolution is validated, a proposition for the following revolution is given. If not, modifications are brought before validation.

VI-2 MODIFICATION OF THE TAF IN THE COURSE OF THE ELABORATION

For numerous reasons, it can be necessary to modify or suppress proposed instructions, or to add supplementary instructions to the base TAF.

The suppression or modification of an instruction is done "manually" in the form of an order given to the calculator.

The introduction of supplementary instructions is also made "manually" in the form of an order given to the calculator but in this case, it is necessary that the calculator delivers, on request, the time of the next satellite/balloon rendezvous considered.

This introduction can also be made automatically by reading a tag on which the different desired actions are introduced "manually" in a simple form (for example balloon no. 033 NSM). The calculator utilizes this data and as a function of the first satellite/balloon rendezvous, transforms it into an instruction which will next be placed automatically in the base TAF. Access to this tag should be permanent, edition of its content ought to be possible at each "publishing."

The elaboration of this TAF necessitates the knowledge of anticipated passage of the satellite above network stations.

VI-3 PERIOD COVERED BY THE TAF - CONTROL

The capacity of the TAF memorandum on board (64 positions) and the fact that the satellite/balloon rendezvous anticipations can only be calculated for limited periods necessitates that each TAF program cover a period of 24 h at the maximum.

When the whole program is validated, the calculator delivers:

- listing giving the TAF such as it has just been defined;

- a perforated tape presenting this program in a form directly comparable by the telecommand coder.

This tape is forwarded to the station retained by the data transmission equipment.

Although this system is for error correction, it is indispensable to check the message received. Also, at the time of reception, the station retransmits to Bretigny the message received which will be compared by the calculator with the message transmitted. This verification is impossible manually on account of the telegraphic code. An output of go - no go style will permit giving the station transmission authorization or will permit retransmitting this message once again.

VI-4 MODIFICATION OF THE TAF IN THE COURSE OF THE EXECUTION

Numerous incidents can be presented in the course of program execution and can impose a new definition of the program.

This new TAF can be identical in every way to the one previously defined, in what concerns the still valid instructions, or can be the object of modification.

If modifications are not necessary, the calculator immediately delivers the listing and the perforated tape corresponding to the still valid portion of the previously defined TAF program. The station retained for sending this new program determines the first valid instruction. If modifications are necessary, one is led back to the preceding case, base TAF, modifications of the TAF in the course of its elaboration.

VI-5 MANAGEMENT OF THE FLOTILLA

A - General location of the balloon in flight

The general location is given in two forms:

cartographic and tabular.

a) Cartographic form

On a planisphere eventually limited between $10^{O}N$ and $70^{O}S$, each balloon in flight is materialized by a character, positioned as a function of the last results obtained. It ought to be possible to select only one part of the map and, in this case, each position is accompanied by the address of the corresponding balloon.

b) Tabular form

In a table, for each balloon in flight, the following information is given:

ADR - LAT - LONG - VIT - AZM - JR/MS/HRMN JR/MS/HRMN B1 B2 B3 B4

ADR: address of the balloon   3 characters

LAT: latitude of the balloon   3 characters

LONG: east longitude of the balloon   3 characters

VIT: module speed in meters/seconds   3 characters

AZM: direction speed   3 characters

JR/MS/HRMN: instant of last interrogation in days-months-hours-minutes   9 characters

JR/MS/HRMN: instant of next interrogation possible in days-months-hours-minutes   9 characters

These two informations are followed by a mark:

J = lighted balloon   N = unlighted balloon

B1 to B4:   balloon parameters in physical sizes

- surrounding temperature   3 characters

- battery voltage   3 characters

- surrounding pressure   c   3 characters

- covering excess pressure   3 characters

A mark ought to designate all the balloons presenting an irregularity such as balloon parameters outside the limit, doubtful location (list of irregularities and corresponding codes to be defined).

The general location is republished at the time of each treatment and for each edition form a "time" mark ought to be given in order to know the most recent data utilizable.

The edition of this location can take place at any instant in the cartographic form and about once every 24 hours in the tabular form.

B - List of the balloons not answering

This list is established by comparison between the list of balloons theoretically seen by the satellite and the list of balloons having answered the calls.

It is established after each treatment and should mention whether each balloon considered was lighted or not, for it is probable that an unlighted balloon does not have the energy necessary to transmit its answer at a sufficient level.

A balloon is retired from this list, automatically or manually, when a response to a call has been obtained or when the balloon is considered as destroyed. Its address will then be utilized for the launching of a new balloon. A mark designates the balloons newly introduced on this list.

The information given for each balloon is identical to that defined for the general location, tabular form.

C - Control of the new balloons

The calculator delivers on request for a particularly designated balloon the information such as it has been defined for the general location. This data also permits supervising the general operation of the covering-nacelle assembly.

<u>Note</u> - In proportion of the launchings, the address of the new balloons in flight is given on the calculator.

VI-6   CONTROL OF THE SATELLITE

The control of satellite operation and the supervision of its attitude are still not defined. It is however necessary to consider supplying, in physical size, a part or all of the parameters transmitted by the dependence telemeasure as well as a restoration of the attitude of the satellite.

The results, furnished on request, are delivered approximately every 24 h or more frequently if there is need.

It is also possible to consider a particular treatment of the parameters joined to the on board energy in order to determine the authorized utilization of the on board equipment without risk of deteriorating the battery.

VII - MATERIAL MEANS

The different information delivered by the calculator are presented with the help of the following means:

VIII - PERSONNEL MEANS

The EOLE operations, such as they are defined require two people - an area chief and an operator - who are permanently devoted exclusively to these operations (or in all 4 x 2 = 8 people).

The reduction to a single person at night is possible if the TAF program is defined every 24 h, but this solution is not desirable for, in case of incidents possibly involving a new definition of the program, a call would be made to the restricted engineer who, not being in the "EOLE area", would have great difficulty in contributing any aid whatsoever.